PROJECT
facts
U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

Sequestration

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CO_2 Separation Using a Thermally Optimized Membrane

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Background

The last decade has witnessed a dramatic increase in the use of polymer membranes as an effective, economic, and flexible tool for many commercial gas separations, including air separation, the recovery of hydrogen from nitrogen, carbon monoxide, and methane mixtures, and the removal of carbon dioxide from natural gas. In each of these applications, processes with high fluxes and excellent selectivities have relied on glassy polymer membranes, which separate gases based on both size and solubility differences. To date, however, this technology has focused on optimizing materials for near ambient conditions.

Los Alamos National Laboratory (LANL), in collaboration with Idaho National Energy and Engineering Laboratory (INEEL), will develop a high-temperature polymer membrane that will exhibit permselectivity for CO_2 an order of magnitude higher than current polymer membranes. The project will focus on the separation of CO_2/CH_4 and CO_2/N_2 gas pairs, which represent separations that are industrially and environmentally important. Capitalizing on the interplay between polymer structure and gas diffusion at temperatures between 100°C and 400°C will lead to structures with unprecedented stability and selectivity. By increasing the rigidity of the thermally stable polybenzimidazole (PBI) backbone and using semi-interpenetrating polymer networks, the researchers will inhibit interchain mobility and control diffusion pathways. This approach will lead to polymer membranes with tunable permeability, polymer modification and casting protocols. This approach will maintain high selectivity while allowing tuning permeability by increasing temperature. Industrial collaboration with Pall Corporation and Shell Oil Company provide the project with direct involvement of world leaders in membrane production and CO_2 separation, respectively.

Primary Project Goal

The purpose of this project is to develop polymeric-metallic membranes for carbon dioxide separation that operate under a broad range of industrially relevant conditions not accessible with present membrane units.

PBI coated metal

CO_2 Separation Using a Thermally Optimized Membrane

Objectives

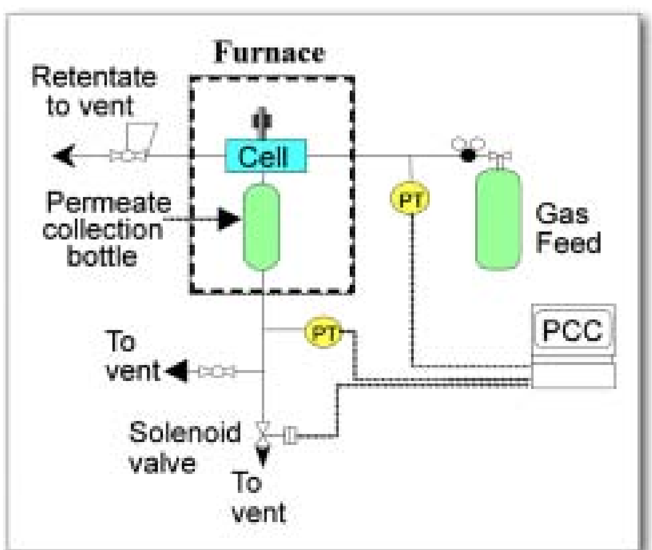
The major objective is the development of polymeric materials that achieve the important combination of high selectivity, high permeability, and mechan-ical stability at temperatures significantly above 25°C and pressures above 10 bar.

Accomplishments

Progress to date includes the first ever fabrication of a polymeric-metallic membrane that is selective from room temperature to 350°C. This achievement represents the highest demonstrated operating temperature at which a polymeric based membrane has successfully functioned. Additionally, the first polybenzamidizole silicate molecular composites have been generated. Finally, a technique has been developed that has enabled the first-ever simultaneous measurements of gas permeation and membrane compaction at elevated temperatures. This technique provides a unique approach to the optimization of long-term membrane performance under challenging operating conditions.

Benefits

The development of high temperature polymeric-metallic composite membranes for carbon dioxide separation at temperatures of 100-450°C and pressures of 10-150 bar will provide a pivotal achievement with both economic and environmental benefits. This technology could further reduce the cost of CO_2 sequestration by providing a CO_2 stream at higher pressures than existing technologies, thereby reducing compression costs significantly.



Membrane Testing Equipment

PROJECT PARTNERS

Los Alamos National Laboratory

Idaho National Energy and Engineering Laboratory

Pall Corporation

Shell Oil Company

COST

Total Project Value:	$1,400,360
DOE Share:	$1,400,360
Non-DOE Share:	$0

CUSTOMER SERVICE

800-553-7681

WEBSITE

www.netl.doe.gov